



Miami Air Route Traffic Control Center
Miami, Florida
Variable Speed Drive Replacement Project

SPECIFICATIONS

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FAA-ZMA-1100135

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SECTION 01 00 00 GENERAL REQUIREMENTS

PART 1 – GENERAL

1.1 SCOPE

- A. These specifications, together with referenced specifications, standards, construction drawings specified on the contract documents and conditions of the construction contract cover the requirements of the Federal Aviation Administration (FAA) for the work associated with this project.

1.2 REPAIR AND PROTECTION

- A. General: Upon completion of inspection and testing, repair damaged construction and restore finishes.
- B. Protect construction exposed by or for quality control service activities, and protect repaired construction.
- C. Repair and protection is Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing, or similar services.

1.3 SEVERE WEATHER PREPAREDNESS PLAN

- A. The contractor shall have a Severe Weather Preparedness Plan that includes hurricanes and tropical storms. It should include items such as:
 - 1. Prior to a severe windstorm such as a tropical storm or hurricane, the contractor shall begin to secure the site and protect the facility as it relates to the construction area, from the elements. The site shall be cleaned and all items that may become airborne shall be secured, tied down or stored properly.
 - 2. 24 hrs prior to a severe windstorm the contractor shall be prepared to evacuate the site for personnel safety.
 - 3. The contractor shall be prepared to commence work within 24 hrs following a severe windstorm.
 - 4. The Government would consider extending the contract based on the number of days the contractor is impacted by a severe windstorm. However, no additional compensation will be considered.

1.4 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
 - 1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of the requirements. Refer uncertainties to the COR for a decision before proceeding.

1.5 RECORD DRAWINGS

The Government shall provide the Contractor with an electronic copy of the record drawings in .pdf format. Changes to the original plans, drawings or shop drawings shall be annotated in red.

END OF SECTION 01 00 00

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SECTION 01 11 00 SUMMARY OF WORK

PART 1 GENERAL

1.1 SUMMARY

- A. Scope of Work - These specifications, together with the referenced specifications, standards, and drawings specified in the contract documents cover the requirements for all work associated with:

1. Remove and replace six (6) VFDs in the control wing attic and 2 VFDs in the Automation wing attic.
2. Controls Contractor shall interface the existing hardwired system with the existing DDCP.
3. Each VFD shall be fully tested with the AHU one at a time before proceeding to the next VFD by the manufacturer's authorized representative .

This work is at the Miami Air Route Traffic Control Center, (ARTCC) located in Miami, Florida. **Prospective bidders are strongly recommended to perform a site visit to assess the actual conditions before submitting a bid. Site visits should be arranged through the Contracting Officer for date and time for a coordinated site visit prior to submittal of bid.**

- B. FAA Holiday Moratorium - No work shall be scheduled or take place during the week of and the weekend preceding and following: The Thanksgiving, Christmas and the New Years Holidays. Only emergency work to restore critical services to the Facility will be considered during these time frames. The moratorium period will not be counted against the contract construction duration of the project.
- C. Intent of Specifications - This specification identifies all material, labor, and equipment required to perform this work. All work performed and all materials and equipment used are subject to approval by the Contracting Officer (CO) and /or the Resident Engineer (RE). This shall include but not limited to inspection, scheduling, reporting and submittals
- D. Contract Documents - The drawings, as shown on the "List of Drawings" in Attachment 2 in each specification package, General and Electrical, all form a part of the construction requirements for this project. The Contractor shall not use dimensions scaled from drawings. All dimensions shown on the drawings shall be field verified by the contractor prior to any modifications and fabrications. Any discrepancies between the drawings and specifications and the existing conditions shall be referred to the CO for adjustment before any work affected is performed.
- E. Precedence of Contract Documents - In the event of a difference between the following contract provisions, the order of precedence to determine which provision shall govern is:
1. Contract Clauses and Provisions
 2. Project Specifications
 3. Project Drawings

Any discrepancies between the contract provisions, the specifications and the contract drawings shall be referred to the CO for a written determination in accordance with Contract Clause entitled Order of Precedence.

- F. Contracting Officer -The term "Contracting Officer" (CO) as used herein denotes the person designated to act on behalf of the Government in the performance of this contract. Where reference is made to "Federal Aviation Administration" (FAA), "Resident Engineer" (RE), "Contracting Officer's Representative" (COR), or the like, this shall mean the Contracting Officer or his/her authorized representative
- G. Contractor Superintendent - In accordance with Contract Clause entitled SUPERINTENDENT BY THE CONTRACTOR, the Contractor shall at all times during performance of this contract and until the work is completed and accepted, directly superintend the work or assign and have on site a competent superintendent with the authority to act for the Contractor.

1.2 SPECIAL REQUIREMENTS

- A. Asbestos Containing Materials. **No new materials to be furnished by the contractor for this construction shall contain asbestos or lead-based products.** The contractor shall verify that all materials, including those supplied by third parties, are asbestos free and/or lead-based free materials.
1. Material Data Safety Sheets - The contractor shall submit Material Data Safety Sheets (MSDS) with all submittals for review and approval by the Contracting Officer. Copies of all MSDS sheets shall be provided to the facility FAA personnel for the building records. The contractor shall comply with all health and safety provisions outlined in each MSDS and shall follow all OSHA guidelines regarding personnel protection.
- B. Work Plan and Scheduling. - The contractor shall submit for approval a plan and schedule of his work. This schedule shall include all of the requirements as defined in Section 01042 of this specification.
- C. Sequence of Work - The contractor shall be responsible for scheduling all aspects of the work and coordinating among the different trades involved in the project. The contractor shall follow the guidelines outlined in the sequence of work as described in the contract drawings. The Federal Aviation Administration has developed a list of milestones that the contractor shall be required to meet.
- D. Milestones –
1. SUBMITTAL APPROVAL
 - FACP and components
 2. ORDER NOTICE TO PROCEED
 - Scheduled by the FAA's CO.
 3. ESTABLISH PROTECTION OF PERSONNEL AND EQUIPMENT.
 4. Demo AHU VFD
 5. Install new VFD
 6. Programming
 7. Complete installation
 8. Testing
 8. Training
 9. CLOSE JOB
- F. Driveway Closures - Contractor shall maintain access to the loading dock at all times.

END OF SECTION 01 11 00

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SECTION 01 14 00 SITE ACCESS, CONSTRUCTION LIMITS, USE OF FACILITIES AND WORK HOURS

PART 1 – GENERAL

1.1 SUMMARY

A. Existing facility operations - Construction/demolition shall in no way interfere with Air Traffic Control Operations. The ARTCC is a 24 hour, seven day a week facility. Extreme care shall be exercised so as not to cause any interference or interruption of service from this facility. Controller functions are vital to the safety of the flying public. It is absolutely mandatory that the contractor protect FAA personnel and existing FAA communication, electrical and mechanical equipment both inside and outside buildings from damaged caused by impact, water, debris or dust. The contractor shall have the overall responsibility for the performance and enforcement of all forms of protection within the ARTCC premises against any damages due to work performed under this contract. Any damages incurred, as a result of construction activity during the performance of this contract will be repaired/replaced immediately by the contractor at no cost to the FAA.

B. Construction limits and access

1. Construction limits. - The contractor shall confine operations, activities, storage of materials and employee parking within the designated areas, as designated by the COR. Additional space the contractor deems necessary shall be obtained off site, at no additional cost to the Government.

2. Access - Access route for the contractor, subcontractors, employees, deliveries, etc., shall be off NW 74 TH Ave. or as designated by the COR. Access to all, parking areas, and loading dock shall be kept unobstructed. If temporary access obstruction is unavoidable, the contractor shall advise the COR immediately. Vehicles transporting materials shall not be loaded beyond the capacity prescribed by federal, state, or local laws. Obstruction of existing roadways, driveways, to the ARTCC is strictly prohibited.

The Contractors' employees shall not use the Cafeteria.

3. Damage to site - Damage to existing paving, lawns, curbs, sidewalks, and utilities caused by the contractor's activities shall be repaired immediately. Any damage to the building, interior or exterior, that are a result of the contractor's activities shall be repaired. All costs of repairs shall be paid by the contractor. After notice to proceed and prior to the commencement of construction, the contractor and COR shall conduct joint inspections of the existing areas affected by the construction. Existing damage or defects shall be noted and will be used as the basis for determination of damages caused by the contractor's operations.

C. Inspection of site by contractor - It is strongly urged that the contractor carefully examine the premises to determine the extent of work and the conditions under which it must be done.

D. Government use and access to premises - The Government reserves the right to enter the construction area at any time for work inspection and for the operation of the facility.

E. Work hours - All work hours, shifts, and overtime work shall be coordinated with the COR. Before commencing construction, furnish to the COR a statement of hours per day and days per week to normally be worked and approximate number of persons on the job for a normal work shift.

F. Security requirements

1. Personnel List - Contractor shall provide the COR with a list of contractor personnel who require access to the ARTCC. The list shall be submitted at least 24 hours prior to gaining admittance into the ARTCC. The list shall be kept current during the project and shall include the following:

Full name, including middle initial

Other documentation as required by ASO 700 for identity validation

2. Security Investigation and identification - Contractor's personnel may be subject to security investigation by FAA. Upon request by the COR, the contractor shall promptly complete all security forms provided by the COR. Contractor's personnel shall report to the FAA security guard at entrance to the facility and submit proper identification when signing in to obtain an FAA badge which will be worn on an outside garment at all times while on the ARTCC premises. This badge shall be returned daily to the security guard when leaving the premises, unless otherwise noted.
3. Vehicle identification - Vehicle identification tags will be issued for contractor's and contractor's employees' vehicles that require access into the ARTCC site. The identification tags shall be displayed in the windshield of the vehicle at all times when the vehicle is on the site. The contractor shall be responsible for the collection and return of all vehicle tags which are no longer required.
4. Escort requirement - Work shall be arranged so that contractor's personnel can be escorted when required by the FAA, in certain areas which are considered to be classified. Contractor's personnel shall not violate any security regulations pertaining to the ARTCC facility. Violators may be removed from the premises with the right to reenter revocable. Contractor's day-to-day work schedules in the classified areas shall be so arranged to allow for minimum escort.
5. Right to search - Current procedures at FAA facilities include the "right to search." If in the judgment of the FAA a cause to search a vehicle or the person of personnel exists, such search will be made.
6. Replacement of lost identification - The FAA will provide personnel badges and vehicle identification tags as described above. It is the contractor's responsibility to return these badges and tags daily and upon completion of the project. The contractor shall be liable to pay for any FAA badge or tag not returned or replaced at the completion of the work. The payment for lost I.D. will be \$10.00 for each and every tag or badge not returned or replaced.
7. Physical Security - At the end of each work day, the contractor shall secure all construction areas by closing and locking all doors and gates. The contractor is responsible for the security of the staging area, and shall provide the required measures at no additional expense to the government.

END OF SECTION 01 14 00

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SECTION 01 31 00 COORDINATION, LOCAL PERMITS AND TESTING

PART 1 – GENERAL

1.1 SUMMARY

- A. Project coordination - It shall be the duty of the Contractor to prepare a detailed schedule of work and work layout to resolve conflicts and to assure coordination of the work by different trades.
- B. Weekly Meeting - Coordination between the COR and Contractor shall take place weekly at the site. Special meetings will be scheduled if requested by either the COR or Contractor. The subjects to be discussed at the progress meetings shall include, but are not limited to, the following:
- Safety concerns/Issues
 - Progress of Work
 - Previous meeting action items/issues
 - Field problems
 - Material and Equipment delivery status
 - Submittal status/schedules
 - Progress planned during the upcoming week(s)
 - Review of changes, and potential effects on the schedule
 - Construction schedule revisions
 - Schedule Revisions
 - Other current business
- C. Facility Coordination Meeting. - Weekly coordination meeting shall take place between the facility managers, COR and the Contractor's Project Superintendent.
- D. Work Affecting Operational Systems. - The contractor shall coordinate all work which has any or may have any impact on any operational system within the facility through the COR. The contractor shall immediately cease any work which is adversely impacting the operation of the ARTCC and shall immediately repair or restore any portion of the operational system that has been damaged or suffered diminished performance as a result of the contractor's activities.
- E. Local permits and Coordination. - The Contractor will be responsible for obtaining and payment of all building fees, inspection fees, utility connection charges and any other fees or charges which may be incurred in the performance of this contract.
- F. Applicable documents. - The contractor shall comply with all local city, county, and state construction codes.

1.2 TESTING

- A. Contractor's responsibility. - Unless otherwise indicated as the responsibility of another identified entity, Contractor shall provide certified testing and inspection agencies, inspections, tests, and other quality-control services specified elsewhere in the Contract Documents and required by authorities having jurisdiction.

END OF SECTION 01 31 00

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SECTION 01 32 16 CONSTRUCTION SCHEDULES

PART 1 GENERAL

1.1 SUMMARY

- A. Description. - The work plan and schedule prepared by the contractor shall consist of a Microsoft Project chart(s) and logical narrative plan. The charts shall show all significant activities and shall include detailed activities when critical work is to be performed. The schedule shall include the mandatory sequence shown in Section 01 11 00, 1.2 D.

1.2 PRODUCTS

- A. Diagrams
1. Show the order of the activities.
 2. Include construction activities, the submittal and approval of materials, samples and shop drawings, the procurement of critical materials and equipment, fabrication of special materials and equipment along with their installation and testing, and costs associated with each activity in the bar chart.
- B. Progress Schedules. - Within 30 days of contract award, the contractor shall submit the schedule and work plan. **A Notice to Proceed will not be issued until the schedule is approved.**

1.3 EXECUTION

- A. Review and Evaluation. - The Contractor shall participate in a review and evaluation of the proposed schedule with the Contracting Officer. Any revisions necessary as a result of the review shall be re-submitted for approval of the Contracting Officer within 14 days after the conference. The approved schedule shall then be used by the contractor for planning, organizing, and directing work, reporting progress, and requesting payment for work accomplished. If the contractor, thereafter, desires to make changes in the schedule, the Contracting Officer shall be notified in writing, stating the reasons for the change. If the Contracting Officer considers the change to be of a major nature, the contractor may be required to revise the schedule and submit it for approval, without additional cost to the government.
- B. Monthly Update. - The contractor shall meet with the COR at monthly intervals to discuss the construction progress. If the project is behind schedule and requires a change in the schedule, the contractor shall submit a revised schedule with a description of the delaying factors and their impact, and an explanation of corrective actions taken or proposed.
- C. Payment. - The monthly update shall show the activities or portions of activities completed during the reporting period, and their total value will be the basis for the contractor's periodic request for payment. Payment will be based on the total value of such activities completed or partially completed after verification by the Contracting Officer.
- D. Submission Requirements. - Schedule charts shall be on (minimum) 11" x 17" size paper. Update charts shall show the date of the latest revision. Schedule charts with revisions and monthly updates shall be submitted in three copies.

- E. Schedule of Values. – The Contractor shall assign to each activity in the schedule, a dollar value associated with that activity. This shall be used as basis for periodic payment calculations.
- F. Requirements for Schedule Chart.
1. Activities.- The significant activities to be included in the schedule chart shall include, but not be limited to:
 - a) The milestones listed in 01011-1.2 (D).
 - b) Any system shutdowns or cut-overs
 - c) Any other significant activities the contractor feels necessary.
 - d) Demo VFD
 - e) Install new VFD
 - f) Conduit install
 - g) Conductor install
 - h) Programming
 - i) Testing
 - j) Training
 - k) A minimum of 20 activities
- G. Shutdown and Cut Over.
1. Electrical Systems. - New construction shall have no impact on the critical or essential electrical service at this facility. However, all electrical connections within live power panels will be scheduled with the COR at least 14 days in advance. All electrical connections to existing panels shall be coordinated with FAA personnel. Equipment shutdown and startup shall be accomplished by FAA personnel.
 2. Fire Alarm and Mechanical Control systems - New construction shall have no impact on the Fire Alarm and Mechanical Control systems. However, all alarm and control connections to active systems will be scheduled with the COR. All connections to the Alarm systems will be done by or under the supervision by the Environmental Support unit.

END OF SECTION 01 32 16

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SECTION 01 33 00 SUBMITTALS

PART 1 – GENERAL

Applicable provisions of this Section and other provisions and requirements of the Contract Documents apply to all sections, except as modified in Sections of Divisions 26.

1.1 SUMMARY

Submit Shop Drawings, product data, samples, warranties, certificates, test reports as required by the contract documents.

1.2 RELATED REQUIREMENTS

- A. Section 01 31 00: Coordination and Testing
- B. Section 01 65 00: Materials and Equipment
- C. Section 01 77 00: Contract Closeout

1.3 SUBMITTALS

Submittals required include, but are not necessarily limited to, the following:

- A. Construction progress schedule
- B. Variable Frequency Drive

1.4 SUBMISSION REQUIREMENTS

- A. Number of Copies - Submit prepaid and in ample time for approval before installation. Unless otherwise noted, submit five (5) copies of documents to the Resident Engineer (RE). Two (2) copies will be retained by the RE. If additional copies are required, provide the quantity and submit additional copies to meet this requirement.
- B. Time for Approval - Receive submittal approvals prior to starting the work. Time necessary for government approval or disapproval of samples, certificates, test reports, and shop drawings will not be more than thirty (30) calendar days after receipt of a submittal. All materials installed in the work shall match the approved submittals. After a submittal has been approved, no substitutions will be permitted without written approval by the RE. No extension of Contract Time will be authorized because of failure to transmit to the RE sufficiently in advance of the Work to permit processing.
- C. Submittal Approval - The checking, marking or approval of the submittal by the FAA shall not be construed as a complete check, but will indicate only that the product or method of construction and detailing is satisfactory. Approval will not relieve the contractor of the responsibility for compliance with the specifications or for any error which may exist. The Contractor shall be responsible for the dimensions and design of

adequate connections, details, and satisfactory construction of all work. Possible approval actions taken by the FAA include:

1. Approved as submitted - If "approved as submitted" is marked by the RE, each copy of the submittal will be identified as having received such approval by being stamped and dated. After submittal has been approved, no substitutions will be permitted without written approval by the RE.
 2. Approved as noted - If "approved as noted" is marked by the RE, the submittal is satisfactory contingent upon Contractor acceptance of corrections, notations, or both, and if accepted, does not require resubmittal.
 3. Not approved - If "not approved" is marked by the RE, the submittal data does not meet job requirements and the Contractor must resubmit. If the submittal is disapproved, the Contractor shall resubmit the corrected material in the same quantity as specified for the original submittal. Correct disapproved submittals and resubmit for approval by the RE. Approval of resubmittals require an additional fourteen (14) calendar days.
 4. Distribution - Following response to the initial submittal, print and distribute copies to the RE, Government, subcontractors, and other parties required to comply with submittal dates indicated. When revisions are made, distribute to the same parties. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.
 5. Schedule Updates - Revise the schedule after each meeting or activity where revisions have been recognized or made.
- D. Construction Progress Schedule – The progress chart to be prepared by the Contractor pursuant to the Contract Clause entitled "SCHEDULES FOR CONSTRUCTION CONTRACTS" shall consist of network analysis system, or pertchart (barchart). The contractor shall be required to complete the work within the contract time limits after receipt of Notice to Proceed excluding the FAA holiday moratorium as specified in section 01 11 00.
1. The diagram shall show a continuous activity flow from left to right. The diagram shall show the sequence in which the work is to be accomplished as planned by the Contractor.
 2. Dates shall be shown on the diagram for start of the project, any milestones required by the contract, and contract completion.
 3. The critical path shall be clearly identified.
 4. Network activities shown shall include submittal and review of shop drawings and samples and procurement of materials and construction activities.
 5. Government activities that affect progress shall be shown. These include but are not limited to: Notice-to-Proceed, approvals, and inspections.

NO PHYSICAL CONSTRUCTION WORK AT THE SITE MAY TAKE PLACE UNTIL THE CONTRACTOR SUBMITS AND THE GOVERNMENT APPROVES THE SCHEDULE. Government review of schedule submittal(s) will not exceed 30 calendar days. Resubmittal, if necessary shall not exceed 14 calendar days.

- E. Two-week "Look Ahead" schedule - This schedule may be of the contractor's choosing, either bar chart or CPM form. Only activities scheduled to be occurring during the forecasted two week time periods are to be shown. Schedules shall be submitted weekly.
- F. Submittals - Submit shop drawings, material and equipment lists, and all other data required under various headings of these specifications necessary to permit commencement of work. RE will return the submittals within 14 calendar days after receipt, indicating approval or disapproval.
- G. Submittal Preparation - Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.
 - 1. Transmittals - All submittals shall be accompanied by transmittal letters identifying the contents of the submittal. It shall be clearly indicated on the transmittal letter with a statement and signature of the Contractor that the submittal item was verified for compliance with the contract requirements and approved by the Contractor. Transmittal letters shall consist of one original.
 - 2. Contents - Submittals shall be complete and detailed and assembled into sets. Lack of completeness or clarity or inadequate description will be justification for disapproval. Submittals shall bear the following information:
 - a) Name of project or facility and contract number;
 - b) Date of submission;
 - c) Contract drawing number and latest revision;
 - d) Specification page and paragraph number;
 - e) Name of contractor and subcontractor or supplier/manufacturer;
 - f) Clearly identified contents and location of work;
 - g) Any proposed variances to specification requirements;
 - h) Contractor's approval certifying he checked and coordinated the work of other trades.

1.5 PRODUCT DATA

- A. Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information, such as manufacturer's installation instructions, catalog cuts, Material Safety Data Sheets (MSDS), standard color charts, roughing-in diagrams and templates, standard wiring diagrams, and performance curves.
- B. Preparation
 - 1. Clearly mark or highlight each copy to identify pertinent site specific products or models the Contractor intends to use
 - 2. Highlight/clearly indicate all performance characteristics and capacities
 - 3. Highlight/clearly indicate all dimensions and clearances required

Note: If the submittal is not clearly marked, regarding the above pertinent data, the submittal will be returned marked "DISAPPROVED".

1.6 WARRANTIES/GUARANTIES

- A. Assemble two (2) copies with original signatures of warranties executed by each of the respective manufacturers, suppliers, and subcontractors into a warranty book and prepare a Table of Contents.
- B. Additional Data - Provide complete information for each item, include the following:
 - 1. Product or work team
 - 2. Firm, with name of principal, address, and telephone
 - 3. Scope
 - 4. Effective dates of warranty based on Final Acceptance of the item.
 - 5. Information for owner's personnel on proper procedures to evoke the warranty in case of failure and instances which might affect the validity of warranty
- C. Warranties - Effective after project completion and acceptance by the FAA.

1.7 CERTIFICATES

Assemble certificates executed by each of the respective manufacturers, suppliers, and subcontractors.

- A. Additional Data - Provide complete information for each item to certify compliance with contract documents.
 - 1. Product or work item
 - 2. Firm, with name of principal
 - 3. Scope of compliance
 - 4. Signature by an officer of the manufacturer or other individual authorized to sign documents on behalf of the company.

PART 2 – MATERIAL

NOT USED

PART 3 – EXECUTION

3.1 GENERAL

Submittals are required for the items listed in the specifications or on the drawings. The following is a partial list of submittals required: Schedules, Manufacturer's Literature, Shop Drawings, Samples, Test Reports, Warranties, Certificates, Design Calculations, MSDS, and Installation Instructions. It should not be construed as a complete list of all submittals required. Submittal dates shall comply with this specification unless a more stringent date is specified. Substitutions and all requested changes will require a submittal.

3.2 SCHEDULE FOR SUBMITTALS

Process after the construction contract has been awarded and prior to NTP:

All Submittals are due 30 calendar days after the contract has been awarded. See below for a list of critical submittals. The construction Notice to Proceed (NTP) will not be issued until all submittals are approved. All other submittals shall be submitted and approved prior to installation or construction. Submittals include the following:

1. Section 01300 - Construction Schedule
2. Section 26 29 23 Variable Frequency Motor Drive (VFD)

No later than two weeks after the contract has been awarded, the Contractor shall be available to participate in a meeting/telecom with the Contracting Officer, Resident Engineer and Office Project Engineer to discuss and coordinate the following:

- 1) Contractor's FAA point of contact for submitting the Submittals.
- 2) Discuss the submittal process and forms.
- 3) Discuss process and forms for request of FAA security badges.
- 4) Discuss the proposed date for Notice to Proceed (NTP)

PART 4 – QUALITY ASSURANCE

NOT USED

*** * * END OF SECTION 01 33 00 * * ***

SECTION 01 65 00 MATERIALS AND EQUIPMENT

PART 1 - GENERAL

1-1 SUMMARY

- A. General. - Material and equipment incorporated into the work shall conform to applicable specifications and standards and comply with size, make, type and quality specified, or as specifically approved in writing by the COR. Manufactured and fabricated products shall be designed, fabricated and assembled in accordance with the best engineering and shop practices. Like parts of duplicate units shall be manufactured to standard sizes and gages and shall be interchangeable. Two or more items of the same kind shall be identical and manufactured by the same manufacturer. Products shall be suitable for service conditions. Equipment capacities, sizes and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing. Do not use material or equipment for any purpose other than for which it is designed or specified. Furnish and install products specified, under options and conditions for substitution stated in this section.
1. Manufacturer's instructions. - When contract documents require that installation of work shall comply with manufacturer's printed instructions, copies of such instructions shall be distributed to parties involved in the installation, including two copies to the COR. Maintain one set of complete instructions at the job site during installation and until completion. Products shall be handled, installed, connected, cleaned and conditioned in strict accordance with such instructions and in conformity with specified requirements. If job conditions or specified requirements conflict with manufacturer's instructions, the contractor shall consult with the COR for further instructions. All work shall be performed in accordance with manufacturer's instructions. No preparatory step or installation procedure shall be omitted unless specifically modified or exempted by contract documents.
 2. Transportation and handling. - Products shall be delivered in undamaged condition, in manufacturer's original containers or packing, with identifying labels intact and legible. Shipments shall be inspected to ensure compliance with requirements of contract documents and approved submittals, and products are properly protected and undamaged immediately on delivery. Provide equipment and personnel to handle products by methods to prevent soiling or damage to products or packing.
 3. Storage. - Unless specified, products shall be stored in accordance with manufacturer's instructions, with seals and labels intact and legible. Products subject to damage by the elements shall be stored in weather tight enclosures.
 4. Temperature. - Temperature and humidity shall be maintained within the ranges required by the manufacturers' instructions. Fabricated products shall be stored above the ground, on blocking or skids to prevent soiling or staining. Products which are subject to deterioration shall be covered with impervious sheet coverings and adequate ventilation shall be provided to avoid condensation.

5. Substitutions. - A separate request for each substitution shall be submitted. Each request shall be supported with complete data substantiating compliance of proposed substitution with the requirements stated in the contract documents. Each request shall include product identification, manufacturer's literature including address, product description, reference standards and performance and test data. Samples shall be submitted as applicable. An itemized comparison of the proposed substitution with the product specified shall be included. The following information shall also be included: data relating to changes in the construction schedule; list of changes required in other work or products; and accurate cost data. Substitute products shall not be ordered or installed without written acceptance. In making a formal request for substitution, the contractor represents that he has investigated the proposed products and has determined that it is equal to or superior in all respects to that specified. The contractor ascertains that he will provide same warranties or bonds for substitutions as for product specified. That he will coordinate installation of accepted substitution into work to be complete in all respects; that he waives claims for additional costs caused by substitution which may subsequently become apparent; and that cost data is complete and includes related costs under his contract. Primarily, an "or equal" product will not be considered a substitution. If an actual substitution is accepted, it shall be done only by formal contract modification and not by a submittal approval.

END OF SECTION 01 65 00

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SECTION 01 73 31 - OSHA SAFETY REQUIREMENTS

PART 1 – GENERAL

1.1 SCOPE

- A. This section identifies some of the requirements of the OSHA Construction Standard.

1.2 CONTRACTOR RESPONSIBILITY

- A. General Safety Provisions - The Contractor shall bear full responsibility to provide safe working conditions for its employees and Contractors. The Contractor shall not permit any employee or Subcontractor to work in surroundings or under working conditions that are unsanitary, hazardous, or dangerous to the health and safety of the employee.
- B. Accident Prevention - The Contractor shall bear the responsibility of maintaining an accident prevention program such that frequent and regular inspections of the job site, materials and equipment are made by a competent person designated by the employer.
- C. Use of Equipment - The Contractor shall not permit the use of any machinery, tool, material, or equipment that is not in compliance with OSHA regulations. The employer shall permit only those employees qualified by training and/or experience to operate equipment and machinery.

1.3 CONTRACTOR RESPONSIBILITY

- A. The FAA shall not be held responsible for safety inspections to assure Contractor conformance with the OSHA safety regulations. The FAA, however, reserves the right to notify the Contractor of any deficiencies regarding worker safety.
- B. The FAA will evaluate the Contractor on its safety performance, including that of its Subcontractors. The number and severity of safety and security violations will be considered in this evaluation. Contractor safety violations are cause for termination for default, may result in notification of the Contractor's bonding company, and will affect the Contractor's opportunity to propose on future work. Failure to correct such deficiencies may impact the Contractor's ability to work on future FAA contracts.

1.4 OSHA REGULATIONS

- A. The Contractor shall comply with the latest Occupational Safety and Health Administration regulations (CFR 29 Part 1926) regarding safety in the work area.
- B. The Contractor shall be responsible for obtaining copies of non-FAA referenced documents without additional cost to the FAA. If Contractor requests a copy of FAA directives may be obtained by contacting the Contracting Officer.

- C. The Contractor is not relieved from adhering to other OSHA requirements not listed herein. The Contractor shall consult the latest referenced OSHA documents for safety regulations.
1. Documents:
- a) OSHA Documents:
- 1) CFR 29 Part 1926 Safety and Health Regulations for Construction
- 2) CFR 29 Part 1910 General Industry Standards Applicable to Construction Industry
- b) FAA Documents:
- 1) FAA Order 3900.49 Control of Hazardous Energy During Maintenance, Servicing and Repair

* * * END OF SECTION 01 73 31 * * *

Division I

Safety and Health Requirements

1. Objectives and Responsibilities

The objectives of the safety and health requirements are to eliminate contractor generated facility shutdowns, interruptions, injuries, illnesses, and incidents. When the Contractor is notified by the Contracting Officer Technical Representative (COTR) of non-compliance with the safety or health provisions of the Contract, the Contractor shall immediately, unless otherwise instructed, correct the unsafe act or unsafe condition.

It is the contractor's responsibility to understand the work to be performed, perform the work in a professional manner and to protect his workforce and FAA from incidents.

2. Communication

A. All contractor tasks must be communicated to FAA prior to the tasks being performed.

A1. Preconstruction Safety Meeting

The FAA will schedule a preconstruction meeting after the Notice to Proceed. The agenda will include:

1. The FAA will identify the Contracting Officer Technical Representative (COTR) and Resident Engineer (RE). The contractor will identify his site management.
2. The FAA will review the chain of authority.
3. The FAA will review the procedure to process field decisions and change orders.
4. The FAA will review the facility safety procedures, and safety and health requirements.
5. The FAA will discuss schedules, shop drawings, product data and samples, manufacturer's certifications of products, manpower reports, equipment deliveries and priorities schedules, procedures for maintaining record documents, use of FAA facilities by contractor (access, parking, office area, and storage area), safety and first aid procedures, security procedures and housekeeping procedures.

A2. Monthly Project Schedule

A detailed schedule must be submitted to FAA monthly. The date the schedule is due will be identified during the preconstruction safety meeting.

A3. Three Week Look-Ahead Schedule

A detailed three week look-ahead schedule must be submitted to FAA weekly. The date the schedule is due will be identified during the preconstruction safety meeting.

A4. Daily Project Scope and Schedule

A detailed daily project scope and schedule must be submitted to the FAA daily. Usually the daily scope and schedule meeting is held early morning with the FAA Resident Engineer. Hot work permits, and electrical/pneumatic/water and steam lockouts are issued daily.

All safety related schedules should be coordinated with the over all work scheduled required in the specifications.

3. Task Specific Safety and Health Plans

All tasks are to be planned and scheduled. All plans must be written and submitted for FAA approval before tasks are performed. The safety and health plan must be compliant with federal safety and health standards (29 CFR 1910 General Industry, 29 CFR 1926 Construction Industry, applicable state safety and health regulations and FAA Orders including Order 3900.19B, Occupational Safety and Health Program. Asbestos containing materials, lead containing coatings, polychlorinated biphenyls, noise and odors are to be controlled.

Required elements of the safety and health plan must include:

1. Coordinate the Safety and Health Plan with the Project Work Plan.
2. Tasks are to be described in detail. All physical and chemical hazards identified, and engineering controls are to be incorporated to eliminate or reduce the hazard.
3. An Emergency Response Plan must be assembled including, where applicable, consideration for fire, explosion, toxic or oxygen deficient atmospheres, water leakage, electrical hazards, slips, trips and falls, confined spaces, heat/cold stress, noise, and odors.
4. Material Safety Data Sheets (MSDS) must be submitted to FAA for all chemicals brought on-site by the Contractor before the chemical is brought on-site.
5. The safety and health plan must include the personal protection equipment to be donned. Hard hats (ANSI Z89.1 or equivalent) must be worn at all times where overhead hazards exist regardless of the workers activities. Shirts with at least four-inch sleeves and appropriate pants shall be worn. Tank tops and shorts are not permitted. Loose or frayed clothing, loose or hanging long hair, ties, rings, body jewelry shall not be worn around moving machinery or other areas where they may become tangled. High visibility shirts, vests, or coats (ANSI/ISEA 107-2004) must be worn at all times while on the project site. Hearing protection must be worn when exposures exceed 85 dBA-TWA. Hard-toe footwear (ASTM F2413, or equivalent) must be worn by all workers when in the construction environment or in areas where there is a danger of foot injuries due to falling, rolling, or piercing objects. Safety glasses with rigid side shields (ANSI Z87.1, or equivalent) must be worn at all times when in the construction environment and in any area where eye hazards exist. Gloves, appropriate for the hazard, must be worn when hands are exposed to physical or chemical hazards.
6. There is a 100% Fall Protection Policy at FAA facilities. Anytime employees are working from an unprotected elevation of six feet or more, fall protection must be incorporated. Working means while traveling, stationary, or at anytime exposed to a fall from a surface not protected by approved handrails, guardrails or some other

- approved fall prevention device. Workers in mechanical lifts, including scissor lifts, boom trucks, suspended or supported personnel baskets, articulating lifts, and other similar devices must use fall protection equipment at all times.
7. Equipment and tools must not be altered in any way to adapt it for a job for which the manufacturer does not intend it.
 8. All hand-held power tools must be equipped with constant pressure switches that will automatically shut off power when the pressure (worker's hand) is removed. Hand-held power tools with on/off or lock-on switches are not permitted.
 9. Ground Fault Circuit Interrupters must be used to protect all temporary electrical wiring and cord sets.
 10. Lock-out/tag-out procedures must be followed to minimize the potential exposure of workers to hazardous energy. Only FAA will energize or deenergize facility electrical circuits. The contractor will connect to temporary power panels only unless specifically approved by FAA. Only FAA will turn on or turn off hot water, chilled water, and steam valves.

Job Hazard Analysis

At the beginning of each work shift, a Job Hazard Analysis/Activity Hazard Analysis or equivalent must be completed jointly by contractor management and craft employees before the work task is performed. Each employee must sign off that they understand the task to be performed, the hazards associated with the task, the controls and PPE required for the task. A copy of the signed off JHA must be transmitted to the FAA daily.

4. Orientation and Training

All contractor employees must complete a site and task specific orientation and test provided by the Contractor prior to tasks in FAA facilities.

Daily Safety Meetings or Tool Box Meetings are to occur before each work shift and include all contractor on-site employees.

5. Incident Investigation

All contractor incidents will be communicated immediately to the FAA Resident Engineer and investigated by the contractor. An incident report and Lesson Learned must be assembled for all incidents and transmitted to the FAA for review.

6. Auditing and Inspections

The contractor must conduct safety and health inspections by qualified and competent professionals at a frequency sufficient to identify and control task specific hazards.

SECTION 01 74 00 CLEANING

PART 1 - GENERAL

1.1 SUMMARY

The scope of this project will be performed in a partially occupied special use environment. Daily cleaning and protection of critical electronic equipment shall be a requirement. All prospective bidders are encouraged to visit the project site to ascertain the criticality of maintaining a clean and dust free environment.

A. Requirements Included.

1. Execute cleaning during the progress of work. This includes but not limited to the following:
 - a) Wipe all surfaces within the limits of work at the end of each shift.
 - b) Vacuum all floors where work took place.
 - c) Remove temporary protective covers at the end of each shift.
2. Execute cleaning for final inspection.
3. Execute cleaning at completion of the work.

RELATED REQUIREMENTS

Section 01 65 00: Materials and Equipment
Section 01 77 00: Contract Closeout.

1.2 PRODUCTS

- A. Materials. - Use only those cleaning materials recommended by the manufacturers of the surface being cleaned so as not to create hazards to health or property.

1.3 EXECUTION

- A. Disposal Requirements. - Conduct cleaning and disposal operations to comply with codes, ordinances, regulations, and anti-pollution laws.
- B. Final Cleaning.
1. Employ skilled workmen for final cleaning.
 2. Remove grease, mastic, adhesive, dust, dirt, stains, fingerprints, labels, and other foreign materials from visible interior and exterior surfaces.
- C. During Construction. - Maintain all areas under Contractor's control free of extraneous debris. Conduct a specific maintenance program to prevent accumulation of debris at the construction site, storage and parking areas, and along access roads and haul routes.
- D. ARTCC Operational Areas. - Clean up after each work shift.

- E. Debris Collection. - Provide containers for debris deposit and schedule periodic collections and disposal of debris. Provide additional collections whenever the periodic schedule is inadequate to prevent accumulation.

END OF SECTION 01 74 00

* * * * *

SECTION 01 77 00 CONTRACT CLOSE OUT

PART 1 - GENERAL

1.1 SUMMARY

The contractor shall require each subcontractor engaged upon the work to bear full responsibility for cleaning up during and immediately upon completion of his work. All rubbish, waste, tools, equipment and other apparatus caused by or used in the execution of his work shall be removed. This shall in no way be construed to relieve the contractor of his primary responsibility for maintaining the building and the site clean and free of debris, and leaving all work in a clean and proper condition acceptable to the COR. All exposed floor surfaces shall be protected against all mechanical damage, mortar or plaster droppings, oil, grease, or other damage that will stain or soil the finish. Protection shall be maintained until all work has been completed.

- A. Rubbish removal. - Immediately after unpacking, all packing material, case lumber, wrappings, or other rubbish, flammable or otherwise, shall be collected and removed from the building and the premises.
- B. Overall cleaning. - Immediately before the final inspection, the entire exterior and interior of the building and the surrounding areas shall be thoroughly cleaned by the contractor, including but not limited to the following:
 - 1. All construction facilities, debris and rubbish shall be removed from the building and the site.
 - 2. All finished surfaces disturbed by this construction shall be swept, dusted, vacuumed, washed or polished as required.
 - 3. All tools, scaffolding, temporary utility connections or buildings, belonging to the contractor or used under his direction shall be removed from the site.

1.2 PROJECT RECORD DOCUMENTS

- A. Maintenance of documents. - The following documents shall be maintained at the project site:
 - 1. Contract drawings
 - 2. Contract specifications
 - 3. Addenda
 - 4. Reviewed shop drawings
 - 5. Change orders
 - 6. Field test reports
 - 7. Project correspondence
 - 8. Other modifications to contract
- B. Storage and use of documents. - Store record documents apart from documents used for construction; do not use record documents for construction purposes. Keep documents in clean, dry, legible condition; provide file cabinets and racks for storage of drawings.
- C. Marking devices. - Use red colored pencil for all marking.
- D. Recording and labeling. - Label each document "Project Record" in 1-inch high printed block letters. Keep record documents current. Do not conceal or cover up any item of work until the information has been recorded.

E. Submittals. - At completion of project, deliver record documents to COR. Accompany submittal with transmittal letter containing the following:

1. Date
2. Project title and number
3. Contractor's name and address.
4. Title and number of each record document
5. Certification that each document as submitted is complete and accurate.
6. Signature of contractor, or his authorized representative

1.3 COMPLETION CERTIFICATE

When the contractor considers the work complete, the contractor shall submit written certification that contract documents have been reviewed; work has been inspected for compliance with contract; equipment and systems have been tested in the presence of the RE and are operational. Second, the contractor also certifies that the required operational, and maintenance manuals, data, and parts list have been submitted and approved; spare parts have been provided as required; required instruction of maintenance personnel had been accomplished; and work is completed, premises cleaned and ready for inspection.

1.4 FINAL INSPECTION

A written request for a final inspection shall be sent to the Resident Engineer fourteen (14) calendar days prior to the requested inspection date. The final inspection shall be scheduled at a mutually agreed upon date, and will be acknowledged by the Resident Engineer. The contractor shall develop his own pre-final inspection and correct all deficiencies prior to requesting the final inspection. The pre-final report shall accompany the final inspection request.

If, during the final inspection, the Resident Engineer, in concurrence with the inspection team and the Contracting Officer, determines that the contractor was not ready for the final inspection, based on the contractor not meeting all of the contractual requirements, all costs incurred by the Government for additional inspections shall be deducted from the contract (including but not limited to: travel cost, per diem, salaries of all concerned parties, consultant engineer personnel, and FAA personnel required to participate in the final inspection). This dollar amount shall be the actual cost incurred by the FAA to perform the final inspection.

1.5 PUNCH LIST

During the final inspection, the Resident Engineer, in coordination with the regional office and local FAA personnel shall develop a list (Punch List) of all deficiencies (unsatisfactory work, latent or patent defects, etc.). A copy of the punch list will be furnished to the contractor as a draft list after the final inspection, while the original copy will be forwarded to the Contracting Officer. Only one official punch list shall be generated by the inspection team.

The Contracting Officer will furnish to the contractor the official punch list within fourteen calendar days after completion of the final inspection. The contractor shall be allowed 30 calendar days to correct all deficiencies noted.

1.6 ACCEPTANCE OF WORK

The contractor shall correct discrepancies noted during the final inspection, clean the premises, and notify the Resident Engineer that the work is ready for acceptance. The Resident Engineer shall verify that the official punch list has been accomplished and initialize and date each item as it is completed.

END OF SECTION 01 77 00

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SECTION 26 05 19 - WIRES AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes building wires and cables and associated splices, connectors, and terminations for wiring systems rated 600 volts and less.

1.2 REFERENCE STANDARDS—Comply with the standards in effect as of the date of the contract documents.

- A. National Electrical Manufacturers Association (NEMA)

WC5: Thermoplastic insulated wire and cable for the transmission and distribution of electrical energy.

- B. Federal Standards (FS)

- 1. W-S-610: Splice connectors
- 2. QQ-W-343: Wire, electrical, copper, insulated

- C. National Electrical Contractors Association (NECA)

- 1. Standard of Installation

- D. National Fire Protection Association (NFPA)

- 1. 70: 2011 National Electrical Code (NEC).

- E. Underwriters Laboratories (UL)

- 1. 486A: Wire connectors for use with copper conductors.
- 2. 486C: Splicing wire connectors.

1.3 SUBMITTALS

- A. Product data for wires and cables. Provide catalog cuts with selections identified to show compliance with spec.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70, NEC, for components and installation.

- B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

- 1. The Terms "Listed and Labeled": As defined in the NEC, Article 100.
- 2. Listing and Labeling Agency Qualifications: A NRTL as defined in OSHA Regulation 1910.7.

1.5 SEQUENCING AND SCHEDULING

- A. Coordination: Coordinate layout and installation of cable with other installations.
 - 1. Revise locations and elevations from those indicated as required to suit field conditions and as approved by the COR.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wire and cable according to NEMA WC-26.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Wires and Cables:
 - a. American Insulated Wire Corporation, Leviton Manufacturing Co.
 - b. Brand-Rex Cable Systems, Brintec Corp.
 - c. Carol Cable Company, Inc.
 - d. Senator Wire & Cable Co.
 - e. Southwire Co.
 - 2. Connectors for Wires and Cables:
 - a. AFC, Monogram Co.
 - b. AMP, Inc.
 - c. Anderson, Square D Co.
 - d. Electrical Products Division, 3M Co.
 - e. O-Z/Gedney Unit, General Signal.

2.2 BUILDING WIRES AND CABLES

- A. UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified in Part 3.2 "Applications" Article.
- B. Thermoplastic Insulation: Conform to NEMA WC 5.
- C. Solid conductor for 10 AWG and smaller; stranded conductor for larger than 10 AWG.
- D. All wire and conduit sizes are based on copper conductors per NEC 70.

- E. Size: Minimum 12 AWG. Minimum 10 AWG for 120 volt circuits where circuit length (one way) exceeds 75 feet from source, and 10 AWG for 277 volt circuits where circuit length (one way) exceeds 150 feet from source.
- F. Material: Copper only
- G. Conductor Color Codes:
 - 1. Feeder conductors to panels and three phase circuits shall be factory color coded as indicated:
 - a. 208/120 Volt System:
 - 1)Phase A: Black
 - 2)Phase B: Red
 - 3)Phase C: Blue
 - 4)Neutral: White
 - 5)Ground: Green
 - b. 480/277 Volt System:
 - 1)Phase A: Yellow
 - 2)Phase B: Brown
 - 3)Phase C: Orange
 - 4)Neutral: Grey
 - 5)Ground: Green
 - 2. Single-phase branch circuits shall be factory color coded as stated above.

2.3 CONNECTORS AND SPLICES

- A. UL-listed factory-fabricated wiring connectors of size, ampacity rating, material, and type and class for application and for service indicated. Select to comply with Project's installation requirements and as specified in Part 3.2 "Applications" Article.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine raceways and building finishes to receive wires and cables for compliance with installation tolerances and other conditions. Verify that the duct or conduit is open, continuous, and clear of debris before installing cable. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Indoor Branch Circuits: Type THHN/THWN, copper conductor, 75 degree C insulation rating in raceway.
- B. Exterior Branch Circuits: Type THHN/THWN, copper conductor, 75 degree C insulation rating in raceway.

- C. Feeders: Type THHN/THWN, copper conductor, 75 degree C rating insulation in raceway.
- D. Fire detection cables and Installation: See section 28 31 00-2.6 and 28 31 00-3.3 respectively.

3.3 INSTALLATION

- A. Install wires and cables as indicated, according to manufacturer's written instructions and the NECA "Standard of Installation."
- B. Pull conductors into raceway simultaneously where more than one is being installed in same raceway.
 - 1. Use pulling compound or lubricant where necessary; compound used must not deteriorate conductor nor insulation, and must be non-flammable.
 - 2. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.
- C. Cable shall be installed in a manner to prevent harmful stretching of the conductor, injury to the insulation or damage to the outer protective covering.
- D. The ends of cables shall be sealed with moisture-seal tape before pulling, and shall be left sealed until connections are made.
- E. Conductor Splices:
 - 1. Splices shall be made only at outlets, junction boxes, or accessible raceways.
 - 2. Splices shall be made with solderless connectors conforming to FS W-S-610.
 - 3. Wire nuts may only be used to splice conductors sized No. 10 AWG and smaller.
 - 4. Compression connectors shall be used to splice conductors No. 8 and larger.
 - 5. All splices, including those made with insulated wire nuts, shall be insulated with electrical tape or heat-shrink tubing to a level equal to that of the factory insulated conductors.
 - 6. Splices shall be made with solderless connectors conforming to UL 486A, UL 486C, and UL 486E.
 - 7. Install splices and insulating tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
 - 8. Use splice and tap connectors that are compatible with conductor material.
 - 9. Splicing methods and material shall be of a type recommended by the manufacturer of the splicing material for the particular type of cable being spliced and shall be approved by the COR prior to installation.
 - 10. Critical power feeders and branch circuits shall not be spliced.
- F. Wiring at Outlets: Install with at least 3 inches of slack conductor at each outlet, per NEC 300.14.
- G. Connect outlets and components to wiring and to ground as indicated. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

- H. Conductors for emergency lighting, telco/LAN, security, and sprinkler alarm systems shall be kept completely independent from any other system as well as each other.
- I. A splice shall not be pulled into a duct or conduit under any circumstance.
- K. Separate neutral and ground wires shall be provided for each overcurrent protection device. Each branch circuit shall have its own neutral and ground conductor. Common neutral or ground conductors are not acceptable.
- L. Install conductors only after the raceway system is complete.
- M. Identify each circuit phase conductor and associated neutral with "Brady" markers each end to designate associated panelboard circuit breaker.

3.4 FIELD QUALITY CONTROL

- A. Insulation Resistance Tests: Feeder and Branch Circuit insulation tests shall be performed after installation, but before connection to equipment.
 - 1. Conductors shall test free from short circuits and grounds, and have a minimum phase-to-phase and phase-to-ground insulation resistance of 30 megohms when measured with a 500-volt DC insulation resistance. The contractor shall submit a letter type test report to the COR prior to final inspection of the Work. The report shall list the tests performed and results obtained.
 - 2. Contractor shall use Megger Test Report Form form located at the end of this section.
- B. Correct malfunctioning products at site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units, and retest.

ATTACHMENT NO. 1

Megger Test Report
600 V CABLE INSULATION AND CONTINUITY TEST
(power/control wire & cable)

Project Name _____
Project No. _____

Date _____ Sheet No. ____ of ____
Address _____

NOTE: 500 VOLT MEGOHMMETER, MEGGER ALL PHASES, RECORD MINIMUM READING

Panel No. Ckt. No. Feeder No.	VOLTS	A-B	A-C	B-C	A-N	B-N	C-N	A-G	B-G	C-G	N-G	SUPERVISOR O.K.

DISTRIBUTION: CENTRAL RECORDS
RE/ENGINEER
CONTRACTOR

RE/ENG/DATE

Contractor Supervisor/Date

END OF SECTION 26 06 19

Section 26 05 29 Hanger and Support for Electrical Systems

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes secure support from the building structure for electrical items by means of hangers, supports, anchors and associated fastenings.

1.2 1.2 REFERENCE STANDARDS--Comply with the latest standard in effect at the time of the invitation for bid documents

- A. National Fire Protection Association (NFPA)
 - 1. 70: 2011 National Electrical Code (NEC)

- B. Underwriters Laboratories (UL)

1.3 SUBMITTALS

- A. Product catalog cut data for each type of product specified with selection identified to show compliance with specifications.
- B. Shop drawings of supports to meet seismic requirements for IBC 2003 Group B Category II.

1.4 QUALITY ASSURANCE

- A. Electrical Component Standard: Components and installation shall comply with NFPA 70.
- B. Electrical components shall be listed and labeled by UL or other approved, nationally recognized testing and listing agency that provides third-party certification follow-up services.

PART 2 - PRODUCTS

2.1 COATINGS

- A. Coating: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic.

2.2 MANUFACTURED SUPPORTING DEVICES

- A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.
- B. Fasteners: Types, materials, and construction features as indicated.

- C. U-Channel Systems: 16-gage steel channels, with 9/16-inch-diameter holes, at a minimum of 8 inches on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacture.
- D. Support systems shall be capable of carrying the weight of the box and its contents.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.
- B. Raceway Supports: Comply with the NEC and the following requirements:
 - 1. Neither raceways nor boxes shall be fastened to suspended ceiling supports.

End of 26 05 29

SECTION 26 05 33 – RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes raceways, fittings, and boxes, for electrical wiring.
- B. Raceways include the following:
 - 1. Rigid galvanized steel (RGS).
 - 2. Liquidtight flexible metal steel conduit(LFMC)—AHU Duct Smoke Detector—three feet lengths
- C. Boxes, enclosures, and cabinets include the following:

- 1. Device boxes, pull and junction boxes---Conduit bodies cast metal for Fire Alarm System

1.2 REFERENCE STANDARDS-Comply with the latest standard in effect at the time of the invitation for bid documents.

- A. American National Standards Institute (ANSI)
 - 1. C80.1: Rigid Steel Conduits
- B. Federal Standards (FS)
 - 1. W-C-586: Conduit outlet boxes, bodies, and entrance caps.
 - 2. W-C-566 Flexible Metal Conduit.
- C. National Electrical Contractors Association (NECA)
- D. National Fire Protection Association (NFPA)
 - 1. 70: 2011 National Electrical Code (NEC).
- E. Underwriters Laboratories (UL)
 - 1. 1: Flexible metal conduit.
 - 2. 50: Enclosures for electrical equipment.
 - 3. 486A: Wire connectors for use with copper conductors.
 - 4. 514B: Fittings for conduit and outlet boxes.
 - 5. 6: Rigid metal conduits.

1.3 SUBMITTALS

- A. Product catalog cut data for raceway, fittings and boxes. Identify each selection to show compliance with spec.

1.4 QUALITY ASSURANCE

- A. Comply with latest edition of the NFPA 70 "National Electrical Code" for components and installation.
 - 1. Boxes shall be sized in accordance with NEC Article 370.
- B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The Terms "Listed and Labeled": As defined in the "National Electrical Code," Article 100.
 - 2. Listing and Labeling Agency Qualifications: A NRTL as defined in OSHA Regulation 1910.7.
- C. Comply with NECA "Standard of Installation."
- D. Coordinate layout and installation of raceway and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Enclosures shall conform to NEMA standards.

2.2 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering Products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Metal Conduit and Tubing:
 - a. Allied Tube and Conduit, Grinnell Co.
 - b. Wheatland
 - 2. Conduit Bodies and Fittings:
 - a. Emerson Electric Co., Appleton Electric Co.
 - b. Hubbell, Inc., Killark Electric Manufacturing Co.
 - c. General Signal, O-Z/Gedney Unit.
 - d. Crouse Hinds

2.3 METAL CONDUIT AND TUBING

- A. Galvanized Rigid Steel Conduit: ANSI C80.1

- B. Liquid tight Flexible Metal Conduit; Zinc-coated steel: UL 1 and Federal Specification WW-C-566. Use only at termination to AHU duct smoke detectors and Fire alarm test devices with three foot length for vibration isolation.
 - 1. Conduit connectors shall be threaded with insulated throat.
- C. Fittings: UL 514B and NEMA FB 1, compatible with conduit and of the threaded type. Set Screw fittings are not allowed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive raceways and boxes, for compliance with installation tolerances and other conditions affecting performance of the raceway system. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine raceways prior to installation. No crushed or deformed raceway shall be installed.

3.2 WIRING METHODS

- A. Indoors: Use the following wiring methods:
 - 1. Rigid galvanized steel conduit shall be used for all branch circuits
 - 2. LMFC(sealtite) to Duct detectors ,etc mounted on AHUs.
 - 2. Boxes and Enclosures Conduit bodies for threaded rigid steel galvanized conduit.

3.3 INSTALLATION

- A. Install raceways, boxes, as indicated, according to manufacturer's written instructions. Install to withstand seismic forces per IBC 2003 Group B Category II as indicated in Section 26 05 29, "Supporting Devices."
- B. The minimum size raceway shall be 3/4 inch .
- C. RACEWAYS:
 - 1. Raceways shall not be attached to the ceiling suspension system.
 - 2. Do not anchor or strap raceways to wall furring channels or to other raceways.
- D. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot water pipes. Install horizontal raceway runs above water and steam piping.
- E. Install raceways level and square and at proper elevations. Provide adequate headroom.
- F. Complete raceway installation before starting conductor installation. Raceways shall be fished and swabbed before conductors are pulled.

- G. Support raceways and boxes as specified in Section 16190 "Supporting Devices."
 - 1. Boxes for fixtures on suspended ceilings shall be supported independently of the ceiling supports.
 - 2. Boxes shall not be supported from sheet-metal roof decks.
- H. Use temporary closures to prevent foreign matter from entering raceway.
- I. Make bends and offsets so the inside diameter is not reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel. No run shall contain more than four (4) 90 degree bends, or the equivalent. Provide pull-boxes, junction boxes, and conduit bodies as required to meet the bends criteria.
- J. Use raceway fittings compatible with raceway and suitable for use and location.
- K. Run concealed raceways with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions, except as otherwise indicated.
- L. Wall Penetrations:
 - 1. Penetrations through walls shall be sealed.
- M. Join raceways with fittings designed and approved for the purpose and make joints tight.
 - 1. Use insulating bushings for all conduits to protect conductors.
- N. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely, and install the locknuts with dished part against the box. Where terminations cannot be made secure with one locknut, or where conduits enter enclosures without threaded hubs, use two locknuts, one inside and one outside the box to securely bond the conduit to the enclosure. In addition a bushing shall be installed on the interior threaded end of the conduit to protect conductor insulation.
- O. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.
- P. Metal conduits shall be mechanically and electrically continuous between outlets, junction and pull boxes, panels, cabinets and similar equipment. Conduits shall enter and be secured to enclosures so that each system is electrically continuous throughout.
- Q. Provide grounding connections for raceway, boxes, and components. Tighten connectors and terminals, including screws and bolts according to equipment manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.
 - 1. Provide grounding bushings for all feeder conduits at switchgear, switchboards, motor control centers, panelboards, transformers, pull boxes, and all other termination points.
 - 2. Where knockouts are used, provide double locknuts, one on each side with a grounding bushing or grounding locknut used on the inside (use grounding bushings on conduit 1" and larger).

- R. Field Cut Conduit: Where conduit has to be cut in the field, it shall be cut square using a hand or power hacksaw or approved pipe cutter using cutting knives. The cut ends of the field-cut conduit shall be reamed to remove burrs and sharp edges.
- S. Boxes: Shall be provided in the wiring or raceway system for pulling wires, making connections, and mounting devices or fixtures. Each box shall have the volume required by NFPA 70 for the number and size of conductors in the box.
 - 1. Outlet boxes: Each outlet box shall have a machine screw which fits into a tapped hole in the box for the ground connection.
 - 2. Concealed wiring: Boxes installed for concealed wiring shall be provided with extension rings or plaster covers. The front edge of the box shall be flush or recessed not more than 1/4" from the finished wall surface.
- T. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line having not less than 200-lb. tensile strength. Leave not less than 12 inches of slack at each end of the pull wire.

3.4 CLEANING

- A. Upon completion of installation of system, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

END OF SECTION 26 05 33

SECTION 26 05 53 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes identification of electrical materials, equipment, and installations.

1.2 REFERENCE STANDARDS—Comply the latest standard in effect at the time of the Invitation for bid documents.

- A. Applicable only to the extent specified.
- B. American National Standards Institute (ANSI)
 - 1. A 13.1: Scheme for the Identification of Piping Systems.
 - 2. C2: National Electrical Safety Code.
- C. National Fire Protection Association (NFPA)
 - 1. 70: 2011 National Electrical Code (NEC).

1.3 SUBMITTALS

- A. Samples for each color, lettering style, and other graphic representation required for tubing, tags, labels, markers, and other identification materials; samples of labels and signs.
- B. Shop drawings showing installation method for each type of identification device.

1.4 QUALITY ASSURANCE

- A. Components and installation shall comply with NFPA 70.
- B. Comply with the requirements of ANSI A13.1 with regard to type and size of lettering for raceway and cable labels.

1.5 SEQUENCING AND SCHEDULING

- A. Coordinate installing electrical identification after completion of finishing where identification is applied to field-finished surfaces.
- B. Coordinate installing electrical identifying devices and markings prior to installing acoustical ceilings and similar finishes that conceal such items.

PART 2 - PRODUCTS

2.1 RACEWAY AND CABLE LABELS

- A. Manufacturer's Standard Products: Where more than one type is listed for a specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.
- B. Conform to ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway or cable size.
 - 1. Color: Black legend on orange field.
 - 2. Legend: Indicates voltage and service.
- C. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl. Legend overlaminated with clear, weather- and chemical-resistant coating.
- D. Heat Shrink Tubing: Preprinted, embossed, permatized, 20-year life. Size to suit conductors; lettering shall be legible after heat shrinking.
- E. Pretensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic bands sized to suit the diameter of the line it identifies and arranged to stay in place by pretensioned gripping action when placed in position.
- F. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 inch wide.
- G. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with pre-printed numbers and letters.
- H. Plasticized Card-stock Tags: Vinyl cloth with pre-printed legends. Orange background, except as otherwise indicated, with eyelet for fasteners.
- I. Brass Tags: Metal tags with stamped legend, punched for fasteners. Dimensions: 2 inches by 2 inches by 0.05 inch.

2.2 ENGRAVED NAMEPLATES AND SIGNS

- A. Manufacturer's Standard Products: Where more than one type is listed for a specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.

- B. Engraving Stock: melamine plastic laminate, 1/16-inch minimum thick for signs up to 20-sq. in., 1/8 inch thick for larger sizes.
 - 1. Engraved Legend: White letters on black field.
 - 2. Punched for mechanical fasteners.
- C. Interior Warning and Caution Signs: Pre-printed aluminum, baked enamel finish with 1/4-inch grommets in corners for mounting.
 - 1. Color, size and legend: appropriate to the application.
 - 2. Punched for fasteners.
- D. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, non-fading, preprinted, cellulose acetate butyrate signs with 0.0396-inch, galvanized steel backing, with colors, legend, and size appropriate to the application. 1/4-inch grommets in corners for mounting.
- E. Fasteners for Plastic-Laminated and Metal Signs: Self-tapping stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

2.3 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6-nylon cable ties with the following features:
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength: 50-lb. minimum.
 - 3. Temperature Range: Minus 40 to 185 deg F.
 - 4. Color: As indicated where used for color-coding.
- B. Paint: Alkyd-urethane enamel over primer as recommended by enamel manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install identification devices according to manufacturer's written instructions.
- B. Install labels where indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.
- C. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations used in the Contract Documents or required by codes and standards. Use consistent designations throughout the Project.

- D. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.
- E. Self-Adhesive Identification Products: Clean surfaces of dust, loose material, and oily films before applying.
- F. Install painted identification as follows:
 - 1. Clean surfaces of dust, loose material, and oily films before painting.
 - 2. Prime Surfaces: For galvanized metal, use single-component, acrylic vehicle coating formulated for galvanized surfaces. For concrete masonry units, use heavy-duty, acrylic-resin block filler. For concrete surfaces, use clear, alkali-resistant, alkyd binder-type sealer.
 - 3. Apply one intermediate and one finish coat of silicone alkyd enamel.
 - 4. Apply primer and finish materials according to manufacturer's instructions.
- G. Identify Raceways with Color Banding: Band exposed and accessible raceways of the systems listed below for identification.
 - 1. Bands: Pretensioned, snap-around, colored plastic sleeves; colored adhesive tape; or a combination of both. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of 2-color markings in contact, side by side.
 - 2. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25 feet in congested areas.
 - 3. Colors: As follows:
 - a) Fire Detection and Alarm—RED
- H. Install Circuit Identification Labels on Boxes: Label externally as follows:
 - 1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover.
 - 2. Concealed Boxes: Plasticized card-stock tags.
 - 3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.
- I. Color-Code Conductors: The following field-applied color-coding methods may be used in lieu of factory-coded wire listed in Section 26 05 19 "Wires and Cables" for sizes larger than No. 4 AWG. Contractor shall demonstrate non-availability of factory colored wire before using this application.
 - 1. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply the last 2 turns of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors as specified. Adjust tape bands to avoid obscuring cable identification markings.
 - a. Where conductors are color coded by this method, they shall be color coded in accessible raceways, panelboards, outlets, and switches, as well as at all terminations.

Conductors in accessible raceways shall be color coded so that by removing or opening any cover, the coding will be visible.

- b. Phase, ground, and neutral conductors shall be color coded in accordance with Section 26 05 19, "Wires and Cables."
2. Green insulated conductors shall not be re-identified for purposes other than grounding.
3. White or neutral gray conductors shall not be re-identified for purposes other than grounded neutrals.

J. Apply identification to conductors as follows:

1. Conduits and Conductors to Be Extended in the Future: Indicate source and circuit numbers.
2. Power and Lighting Circuits at Enclosure and at terminations: Identify each conductor with panel designation, circuit number, voltage, and phase.
3. Control and Communications Circuits at Enclosure and at terminations: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.

K. Apply warning, caution, and instruction signs and stencils as follows:

1. Install warning, caution, and instruction signs where indicated or required to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation.
2. Emergency-Operating Signs: Install engraved laminate signs with white legend on red background with minimum 3/8-inch-high lettering for emergency instructions on power transfer, and other emergency operations.

L. Install identification as follows:

1. Apply equipment identification labels of engraved plastic laminate on each major unit of equipment, including central or master unit of each system. This includes communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Provide equipment, required under Division 26, as follows: with nameplate indicating equipment name, system voltage(s) and phase (for example: EF203, 480V, 3 phase). Except as otherwise indicated, provide a single line of text with 1/2-inch-high lettering on 1-1/2-inch-high label; where 2 lines of text are required, use 2-inch-high label. Apply labels for each unit of the following categories of equipment:
 - a) Panelboards, electrical cabinets, and enclosures.
 - b) Access doors and panels for concealed electrical items.
 - c) Motor starters.
 - d) Control devices.
2. Label conduit at each end and at pull boxes with characters a minimum 1/4-inch high.

3. Apply designation labels of engraved plastic laminate for disconnect switches, breakers, push buttons, pilot lights, and similar items for power distribution and control components above, except panelboards and alarm/signal components where labeling is specified elsewhere. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.

END OF SECTION 26 05 53

SECTION 26 29 23- VARIABLE-FREQUENCY MOTOR DRIVE (VFD)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes separately enclosed, pre-assembled, combination VFDs, rated 480 V 3 wire for speed control of three-phase, squirrel-cage induction motors (ie AHU fan motors).
- B. Each VFD shall be controlled by the existing DDCP. The controls contractor (Prenova) shall be contracted to verify compatibility of the I/O and controls with the existing INET 7 DDCP make the proper connections and verify system operation during testing.
- C. Each VFD shall be fully tested with the AHU by the manufacturer's authorized representative.

1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. CPT: Control power transformer.
- C. EMI: Electromagnetic interference.
- D. IGBT: Insulated-gate bipolar transistor.
- E. LED: Light-emitting diode.
- F. MCP: Motor circuit protector
- G. NC: Normally closed.
- H. NO: Normally open.
- I. NRTL: Nationally Recognized Testing Lab (ie UL).
- J. OCPD: Overcurrent protective device.
- K. PID: Control action, proportional plus integral plus derivative.
- L. PWM: Pulse-width modulated.

- M. RFI: Radio-frequency interference.
- N. TDD: Total demand (harmonic current) distortion.
- O. THD(V): Total harmonic voltage distortion
- P. VFD: Variable-frequency drive motor controller.
- Q.. DDCP---Digital data control panel
- R. UL: Underwriters Laboratories

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: VFDs shall withstand the effects of earthquake motions determined according to IBC 2006 seismic design category “A”.
 - 1. The term “withstand” means “the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type and rating of VFD indicated. Include features, performance, electrical ratings, operating characteristics, shipping and operating weights, and furnished specialties and accessories.
- B. Shop Drawings: For each VFD indicated. Include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting arrangements, and details, including required clearances and service space around equipment.
 - 1. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Each installed unit’s type and details.
 - b. Factory-installed devices.
 - c. Enclosure types and details.
 - d. Nameplate legends.
 - e. Short-circuit current (withstand) rating of enclosed unit.
 - f. Features, characteristics, ratings, and factory settings of each VFD and installed devices.
 - g. Specified modifications.
 - 2. Schematic and Connection Wiring Diagrams: For power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around VFDs. Show VFD layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.
- B. Qualification Data: For qualified testing agency.
- C. Seismic Qualification Certificates: For VFDs, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.
- D. Product Certificates: For each VFD, from manufacturer.
- E. Harmonic Analysis Study and Report: Prepare a computer generated report from the VFD manufacturer based on the facility electrical one line provided by FAA. Results to indicate compliance with IEEE 519-1992 (Tables 10.2 and 10.3) at the (PCC) power company transformer primary. The maximum values for total voltage distortion shall be 3% and total current distortion 5% at the point of common coupling (PCC).
- F. Load-Current and electronic adjustable overload relay List: Compile motor full load currents for existing AHU motors to demonstrate that selection of motor starter adjustable solid state overload device suits actual motor nameplate, full-load currents.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Manual: For VFDs, include the manufacturer's installation, programming, troubleshooting, operation, and maintenance data in the manuals. In addition include these items:
 - 1. Manufacturer's written instructions for testing and adjusting input thermal-magnetic circuit breaker .
 - 2. Manufacturer's written instructions for setting field-adjustable overload relays.
 - 3. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
 - 4. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.

1.8 QUALITY ASSURANCE

- A. VFD shall have a minimum MTFB (Mean Time Between Failure) rating of 10 years.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside controllers and install temporary electric heating, with at least 250 W per controller] [connect factory-installed space heaters to temporary electrical service.

1.10 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than 14 deg F and not exceeding 104 deg F.
 - 2. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F.
 - 3. Humidity: Less than 95 percent (noncondensing).
 - 4. Altitude: Not exceeding 3300 feet.
- B. Interruption of Existing Electrical Systems: Do not interrupt electrical systems in the facility. Only FAA authorized personnel shall operate any circuit breaker. See Div 1 for notification requirements to request removing electrical power from any unit or taking an AHU out of service.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFDs, including clearances between VFDs, and adjacent surfaces (ie ceilings, duct work ,guard rails, etc) and other items.

1.11 COORDINATION

- A. Coordinate features of motors, load characteristics, installed units, and accessory devices to be compatible with the following:
 - 1. Torque, speed, and horsepower requirements of the load.
 - 2. Ratings and characteristics of supply circuit and required control sequence.
 - 3. Ambient and environmental conditions of installation location.

1.12 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace VFDs that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

Basis-of-Design Product: Subject to compliance with requirements, provide the Yaskawa America Inc. E7B as this configuration is sized for the limited mounting space, currently interfaces with the DDCP, utilizes existing electrical feeder conduits, interfaces with the existing Magnetek motors, and meets the harmonic and RFI requirements or manufacturers offering VFDs which are subject to compliance with existing installation requirements and this specification may be incorporated in the work.

1. All VFD manufacturer's submittals shall show compliance with the specification, plans, testing, and interface with the DDCP.
- B. General Requirements for VFDs: Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508C.
- C. Application: Variable torque.
- D. VFD/3 contactor Bypass Description: Variable-frequency power converter (IGBT, PWM inverter) factory packaged in an enclosure, with 3 contactor Bypass, integral disconnecting means and overcurrent and overload protection; listed and labeled by UL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one three-phase induction motors by adjusting output voltage and frequency.
 1. VFD shall be suitable for operation of existing Magnetek NEMA MG 1, Design A (10 hp) and Design B (30hp) motors as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
 2. VFD shall be suitable for operation of existing continuous-duty motors as defined by NEMA MG 1.
 3. Listed and labeled for integrated short-circuit current (withstand) rating (min 18KAIC) by UL .
- E. Design and Rating: Match VFD to AHU direct drive fan motor steady state and starting load.
- F. Output Rating: Three-phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.
- G. Unit Operating Requirements:
 1. Input AC Voltage Tolerance: Plus 10 and minus 15 percent of VFD input voltage rating.
 2. Input AC Voltage Unbalance: Not exceeding 3 percent.
 3. Input Frequency Tolerance: Plus or minus 5 percent of VFD frequency rating.
 4. Minimum Efficiency: 98 percent at 60 Hz, full load.
 5. Minimum Displacement Primary-Side Power Factor: 98 percent under any load or speed condition.
 6. Minimum Short-Circuit Current (Withstand) Rating: 18 kAIC
 7. Ambient Temperature Rating: Not less than 14 deg F and not exceeding 104 deg F.

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8. Ambient Storage Temperature Rating: Not less than minus 4 deg F and not exceeding 140 deg F.
 9. Humidity Rating: Less than 95 percent (noncondensing).
 10. Altitude Rating: Not exceeding 3300 feet.
 11. Vibration Withstand: Comply with IBC 2006 seismic category "A".
 12. Overload Capability: 1.1 times the base load current for 60 seconds; minimum of 1.8 times the base load current instantaneously.
 13. Starting Torque: Minimum 100 percent of rated torque from 3Hz to 60 Hz.
 14. Speed Regulation: Plus or minus 3 percent.
 15. Output Carrier Frequency: Selectable; 5 to 15 kHz.
 16. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.
 17. RFI—VFD must meet the requirement for RFI suppression above 7MHz as specified by FCC regulations part 15 subpart J, class A devices.
 18. VFD shall provide terminals for remote input contact closure to allow starting in the automatic mode
- H. Inverter Logic: Microprocessor based, 32 bit, isolated from all power circuits.
- I. Isolated Control Interface: Allows VFDs to follow remote-control signal over a minimum 40:1 speed range.
1. Signal: Electrical.
- J. Internal Adjustability Capabilities:
1. Minimum Speed: 5 to 25 percent of maximum rpm.
 2. Maximum Speed: 80 to 100 percent of maximum rpm.
 3. Acceleration: 0.1 to 999.9 seconds.
 4. Deceleration: 0.1 to 999.9 seconds.
 5. Current Limit: 30 to minimum of 150 percent of maximum rating.
- K. Self-Protection and Reliability Features:
1. Input transient protection by means of surge suppressors to provide three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
 2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
 3. Under- and overvoltage trips.
 4. Inverter overcurrent trips.
 5. VFD and Motor Overload/Overtemperature Protection: Provide UL approved electronic thermal overload relay to protect both drive and motor.
 6. Critical frequency rejection, with three selectable, adjustable deadbands.
 7. Instantaneous line-to-line and line-to-ground overcurrent trips.
 8. Loss-of-phase protection.
 9. Short-circuit protection.

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- L. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.
 - M. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless “Bidirectional Autospeed Search” feature is available and engaged.
 - N. Bidirectional Autospeed Search: Capable of starting VFD into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.
 - O. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds..
 - P. Integral Input Disconnecting Means and OCPD: NEMA AB 1, instantaneous-trip circuit breaker with pad-lockable, door-mounted handle mechanism.
 - 1. Disconnect Rating: Not less than 115 percent of VFD input current rating.
 - 2. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFD input current rating, whichever is larger.
 - 3. Auxiliary Contacts: NO/NC, arranged to activate before switch blades open.
 - 4. Auxiliary contacts “a” and “b” arranged to activate with circuit-breaker handle.
 - 5. [NC] [NO] alarm contact that operates only when circuit breaker has tripped.

2.2 CONTROLS AND INDICATION

- A. Status Lights: Door-mounted LED indicators displaying the following conditions:
 - 1. Power on.
 - 2. Drive Run.
 - 3. Bypass Run.
 - 4. Overload safety Fault
 - 5. Drive Fult
- B. Panel-Mounted Operator Station: Manufacturer’s standard front-accessible, sealed keypad and plain-English language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
 - 1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
 - 2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.
 - a. Control Authority: Supports at least four conditions: Off, local manual control at VFD, local automatic control at VFD, and automatic control through a remote source.

- C. Historical Logging Information and Displays:
1. Real-time clock with current time and date.
 2. Running log of total power versus time.
 3. Total run time.
 4. Fault log, maintaining last four faults with time and date stamp for each.
- D. Indicating Devices: Digital operator display and additional readout devices as required, mounted flush in VFD door and connected to display VFD parameters including, but not limited to;
1. Frequency reference (Hz)
 2. Output frequency (Hz)
 3. Motor status (running, stop, fault, Bypass)).
 4. Output current (amperes).
 5. Output voltage (volts)
 6. Fault or alarming status (code).
 7. PID feedback signal (percent).
 8. DC-link voltage (V dc).
 9. Motor torque (percent)
 10. Kilowatts
 11. Kilowatthours
 12. Elapsed time
- E. Control Signal Interfaces:
1. Electric Input Signal Interface:
 - a. A minimum of two programmable analog inputs: 0- to 10-V dc.
 - b. A minimum of six multifunction programmable digital inputs.
 2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BAS or other control systems:
 - a. 0- to 10-V dc.
 - b. 4- to 20-mA dc.
 - c. Potentiometer using up/down digital inputs.
 - d. Fixed frequencies using digital inputs.
 3. Output Signal Interface: A minimum of one programmable analog output signal(s) (0- to 10-V dc), which can be configured for any of the following:
 - a. Output frequency (Hz).
 - b. Output current (load).
 - c. DC-link voltage (V dc).
 - d. Motor torque (percent).
 - e. Motor speed (rpm).
 - f. Set point frequency (Hz).

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4. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
 - a. Motor running.
 - b. Set point speed reached.
 - c. Fault and warning indication (overtemperature or overcurrent).
 - d. PID high- or low-speed limits reached.
 - F. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans for pressure, or temperature regulation.
 1. Number of Loops: One.
 - G. BAS Interface: VFD to operate and interface with the existing INET 7 DDCP system data points.. The VFD shall have optional communications bus for BACnet for future use with a new control system.
- 2.3 LINE CONDITIONING
- A. Input Line Conditioning: Provide 5% DC bus reactor for harmonic mitigation.
- 2.4 THREE CONTACTOR BYPASS PACKAGE
- A. Three contactor manual Bypass, bypass components and VFD shall be provided inside a common NEMA 1 enclosure, fully pre wired and ready for installation as a single UL listed device. The enclosure size shall be approximately 32"hx19"wx14"d to match existing space and conduit installation. The Bypass shall include the following:
 1. Input, output, and bypass IEC rated contactors electrically interlocked to disconnect power to the VFD, when motor is running in the bypass mode.
 2. 120VAC control transformer, with fused primary with 100VA for damper use.
 3. Adjustable thermal overload relay to protect the motor while operating in both the drive and bypass mode.
 4. Circuit breaker (MCP)/disconnect switch with a padlockable through the door handle mechanism.
 5. Control and safety circuit terminal strip.
 6. Drive/Bypass selector switch, Hand/Off/Auto selector switch, Normal/Test selector switch.
 7. Pilot lights (22mmLEDs) for "Control Power", "Drive Fault", "Drive run", "Bypass Run", and "O/L Safety Fault".

8. Normal/Test Selector switch shall allow testing and adjustment of the VFD while the motor is running in the bypass mode.

9. Hand/Off/Auto selector switch shall provide the following operation:

a. Hand Position---The drive is given a start command, operation is via the local speed input(digital operator). If in bypass the motor is running.

b. Off Position---The start command is removed, all speed inputs are ignored, power is still applied to the drive. If in bypass the motor is stopped.

c. Auto Position----The drive is enabled to receive a start command and speed input from a building automation system. If in the bypass mode, the motor start/stop is controlled by the building automation system.

10. Annunciation contacts for drive run, drive fault, bypass run and motor O/L safety fault.

11. Damper control circuit with end of travel feedback capability.

12. VFD operator/keypad selection—LCD

13. H/O/A control panel selection—Rotary selector switch type.

2.5 OPTIONAL FEATURES

A. Communication Port: RS-422/485 port, or equivalent connection capable of connecting to building Automation System.

2.6 ENCLOSURES

A. VFD Enclosures: NEMA 250, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: Type 1.

2.7 ACCESSORIES

A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFD enclosure cover unless otherwise indicated.

1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty type.

a. Push Buttons: Covered types.

b. Pilot Lights: LED types; green; push to test.

c. Selector Switches: Rotary type.

d. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

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- B. NO bypass contactor auxiliary contact(s).
 - C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.
 - D. Phase-Failure, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
 - 1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.
 - E. Cooling Fan and Exhaust System: For NEMA 250, Type 1; UL 508 component recognized: Supply fan, 120-V ac; obtained from integral CPT.

2.8 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect VFDs according to requirements in NEMA ICS 61800-2.
 - 1. Test each VFD while connected to its specified motor.
 - 2. Verification of Performance: Rate VFDs according to operation of functions and features specified.
- B. VFDs will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, surfaces, and substrates to receive VFDs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance.
- B. Examine VFD before installation. Reject VFDs that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFD installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Coordinate layout and installation of VFDs with existing AHU, guard rails, unistrut frames, existing chiller piping, and existing conduits. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Unistrut frames--Mounting Controllers: Install VFDs on existing unistrut in attic at location shown. Modify for actual VFD enclosure.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Adjust thermal-overload relays based on actual nameplate full-load amperes. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- E. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify VFDs, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each VFD with engraved nameplate.
 - 3. Label each enclosure-mounted control and pilot device.
- B. Operating Instructions: Frame printed operating instructions for VFDs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic for future mounting adjacent to VFD enclosure.

3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between VFDs and remote devices.
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic control devices where applicable.
 - 1. Connect selector switches to bypass only those manual- and automatic control devices that have no safety functions when switches are in manual-control position.
 - 2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 CONNECTIONS

A. Do not energize the VFDs until the factory authorized service representative has performed the initial startup inspection and has verified that the drives can be energized. Follow manufacturer's recommended start up procedures.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Start up Service: Engage a factory-authorized service representative to inspect field assembled components and equipment installation, including pretesting and adjusting VFDs..
1. Complete installation and start up checks according to manufacturer's written instruction.
 2. Verification of wire terminations.
 3. Installation verification of proper operation of the VFD, motor and DCP control
 4. Verification of motor voltage and frequency, proper control input and set point adjustment of minimum speed, maximum speed, acceleration and deceleration rates, and resonant frequency lockouts.
 5. As a minimum measure and record on manufacturer's start up data sheet voltages/current at the output of the drive and at the motor in drive and Bypass mode.
 6. Correct malfunctioning units on site, where possible and retest to demonstrate compliance; otherwise replace with new units and retest.
- B. Provide laminated VFD operating instructions for future attachment adjacent to the enclosure.
- C. Test reports: Prepare a written report to record the following:
1. Test procedures used
 2. Test results that comply with requirements
 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

3.7 ADJUSTING

- A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.
- B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes. Where these maximum settings do not allow starting of a motor, notify FAA COTR before increasing settings.

D. Set field-adjustable circuit-breaker trip ranges as specified.

3.5 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.
- B. Replace VFDs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train FAA ESU maintenance personnel to adjust, operate, reprogram, and maintain VFDs. Provide three 8 hour training sessions. Courses must include Keypad navigation, review of user's manual, programming for typical HVAC application, maintenance, and review troubleshooting guide. Courses shall be prepared for three persons in each session. Instructors must be certified by the manufacturer. Equipment installers are not acceptable instructors.

END OF SECTION 26 29 23

